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RESEARCH ARTICLE

Building capacities for transformative change towards sustainability: Imagination in Intergovernmental Science-Policy Scenario Processes

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Scenario development has been recognized as a potential method to explore future change and stimulate a reflective process that can contribute to more informed decision-making. The assessment process under IPBES (the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) has however shown that the current predominantly biophysical and economic models and scenario processes for exploring the future of biodiversity, ecosystem services and their contributions to human wellbeing are insufficient to capture the complexity and context-specific nature of the problems facing these sectors. Several important challenges have been identified that require a more in-depth analysis of where more imaginative scenario efforts can be undertaken to address this gap. In this paper, we identify six key characteristics necessary for scenario processes: adaptability across diverse contexts, inclusion of diverse knowledge and value systems, legitimate stakeholder engagement that foregrounds the role of power and politics, an ability to grapple with uncertainty, individual and collective thinking mechanisms and relevance to policy making. We compared four cases of imaginative, arts-based scenario processes that each offer aspects of meeting these criteria. These approaches emphasise the importance of engaging the imagination of those involved in a process and harnessing it as a tool for identifying and conceptualising more transformative future trajectories. Drawing on the existing literature, we argue that there is value in fostering more inclusive and creative participatory processes that acknowledge the importance of understanding multiple value systems and relationships in order to reimagine a more inclusive and just future. Based on this, we reflect on future research to understand the transformative role that imagination can play in altering and enhancing knowledge-making for global assessments, including IPBES. We conclude that creative scenario co-development processes that promote imagination and create an opening for more empathetic responses should be considered as complementary tools within the suite of methodologies used for future IPBES scenario development.

Keywords: Scenarios; Imagination; Transformation; IPBES; Co-production; Arts

1. Introduction

"Knowledge is empty without imagination, without spirit, without the heart... no civilization ever became great on knowledge alone" (Okri 2015: 14)

Modelling and assessment exercises conducted at a global level continue to show a broad-based decline in most ecosystem services and biodiversity as a result of various anthropogenic forces (Millennium Ecosystem Assessment, 2005; Butchart et al., 2010; Pereira et al., 2010; Steffen et al., 2015; IPBES, 2019; UN Environment, 2019). These declines have significant effects on human wellbeing, livelihoods and future development potential (Díaz et al. 2006; Haines-Young and Potschin 2010; Millennium Ecosystem Assessment 2005). The rapid pace and scale of social-ecological challenges in the Anthropocene – i.e. the new geological era where human activities have become the dominant force shaping the planet (Steffen et al., 2018) – require new and integrated methods for conceptualizing and understanding alternative futures and co-designing transformative responses (Bai et al., 2016). Increasingly, a significant portion of the literature

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is focused on elucidating processes of deliberate transformations of social-ecological systems to ensure human wellbeing and the provision of ecosystem services over time (Moore et al., 2014). More specifically, some studies are also increasingly exploring issues related to power asymmetries and social justice to better understand how transformations can be more inclusive and equitable (Leach et al., 2010; Jasanoff, 2015; Ziervogel et al., 2017). Researchers have also highlighted the need to consider radical transformations towards sustainability in more plural and political ways (Blythe et al., 2018).

Current tools for exploring the future of biodiversity, ecosystem services and their contributions to human wellbeing are mainly anchored in the natural sciences and take the form of linked biophysical and economic models—much like the integrated assessment models used by the Intergovernmental Panel for Climate Change (IPCC). Recent research has shown that modelling methods are insufficient to capture the complexity and context-specific nature of the problems they seek to help understand (Kok et al., 2016; Vadrot et al., 2016; Rosa et al., 2017). A singular focus on quantifiable knowledge with immediately verifiable, and extrapolatable data points as the basis for framing the future, has created an imagination gap for creatively thinking about futures – and can limit innovative ways of navigating and co-envisioning more sustainable pathways through an uncertain future. As has been pointed out by Bendor (2018, p. 132), “the path to sustainability is obstructed by our own inability as individuals and as a collective to imagine what a sustainable future may look like. We are facing a crisis of the imagination, or more accurately, crises of our social, economic, and political imaginaries”. Imagination “can help us step away from, and cast a critical eye toward existing institutions and practices, and envision radically different futures” (Milkoreit, 2016: 172). Scenario development has been recognized as a potential method to explore future changes, as an alternative to modeling, that is able to foster social imagination (Miller, 2006) and thus stimulate a reflective process that can result in more informed decision-making (IPBES, 2016). However, many of the existing scenarios for biodiversity and ecosystem services follow an archetypal approach and do not make full use of the potential power of social imaginaries (Bennett et al., 2016).

Rather than portraying or predicting what will happen in the future, scenarios as defined here, are coherent, internally consistent, and plausible descriptions of potential future trajectories of a system (Heugens and van Oosterhout, 2001). Scenarios may have different targets and goals (e.g. scientific exploration, educational and information building, strategic planning and decision support), they may have an exploratory or normative focus (i.e. target-seeking or policy screening oriented scenarios), they may be entirely qualitative storylines or, they may integrate findings from mathematical-based models, to represent divergent, mutually exclusive futures such as in the IPCC (See IPBES, 2016). Although high-profile scenarios have been elaborated without the participation of stakeholders (e.g. Millennium Ecosystem Assessment (See Cork et al., 2005), IPCC’s Shared Socio-economic Pathways scenarios (SSPs) (See O’Neill et al., 2017)), several arguments

are made for more participatory scenario building i) to engage people who have the right to have their voice heard in decisions about their future (Reed, 2008); ii) to include different worldviews and knowledge systems (von Wirth et al., 2014); iii) to produce more robust knowledge on complex systems and uncertainty (Kok et al., 2007; Walz et al., 2007); iv) to legitimize decisions taken (Chaudhury et al., 2013); v) and to reinforce the process of social learning and change (Ravera et al., 2011; Reed et al., 2013).

In this paper, we focus on the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Service (IPBES) process that is attempting to explore more diverse and participatory scenario methodologies to provide useful guidance to decision-makers around the challenges of biodiversity conservation and management (Rosa et al., 2017). The aim of the paper is to contribute to the ongoing IPBES scenario development process design by highlighting different ways of introducing imagination as a key component in the scenario co-development process. We specifically explore four examples of different scenario approaches that creatively engage arts and harness imagination as a tool for thinking about more transformative future trajectories.

1.1. Key challenges associated with scenario-based futures thinking

In addition to their numerous benefits (See Peterson et al., 2003; Van Vuuren et al., 2012; Bennett et al., 2016), scenario-based futures thinking also present challenges.

Firstly, scenarios developed in combination with models through a reductionist, technocratic and top-down knowledge production process, mainly based on partial knowledge of past and present trends or biased assumptions, are unable to account for complex and unexpected feedbacks loops and surprises among components of social-ecological systems (Clark et al., 2016). Thus, as suggested by Leach et al., (2010), estimating the likelihood of occurrence of a given scenario (as in the IPCC process) collapses and simplifies the dimensions of irreducible uncertainty, ambiguity and unknown unknowns to narrower notions of ‘risk.’ However, the “unprecedented problems” that characterize the Anthropocene need “unprecedented solutions” (Milkoreit 2016: p. 172) that current projections and scenario exercises have not been able to capture. As a result, such scenario processes are not well suited to address systems thinking or complexity (Dieleman and Huisingh, 2006). The technocratic strategies proposed as solutions by such processes are not able to envision transformations of complex social-ecological systems – i.e. radical multi-scale changes away from current unsustainable pathways (Moore et al., 2014).

Secondly, as suggested by critical and post-colonial feminist scholars exploring climate change and the future of human-nature relations, current scenarios and modelling approaches adopted to represent the future of global change impacts on the environment and society conjure an apolitical vision of science (MacGregor, 2009; Israel and Sachs, 2013). These approaches reaffirm the general credibility and authority of positivist western science, while excluding other voices – especially marginalized voices such as women’s or indigenous voices – which

may have different and relevant knowledges, representations or worldviews and solutions (Díaz et al., 2018). Silencing such multiple voices and knowledges about future drivers, impacts and solutions in the present can make these diverse values, perceptions, experiences and contradictions seemingly invisible and limit transformative pathways (Leach et al., 2010). As it is usually those most affected by global environmental change who are excluded from contributing to decision-making processes, these 'invisible' voices are needed to co-define possible futures in different contexts (Kaijser and Kronsell, 2014; Thompson-Hall et al., 2016). In this regard, including multiple voices and their collective imaginations in scenario exercises can assist with addressing power asymmetries in knowledge co-production processes and among stakeholders and other actor groups within society and move towards the co-development of more inclusive futures.

Finally, given that modelling and scenario analyses are usually developed using positivist methods based on statistics, the future is often 'predicted' from the probable and desirable (Miller 2007), without acknowledging the role of embodied fears, hopes, emotions and intuitions, which are necessary precursors in (re)imagining transformative futures. Recognizing and incorporating the aspects that make us human may enable us, individually and collectively, to understand, evaluate and perhaps even manage the emotional and moral dilemmas that come with planetary-scale challenges. Rickinson et al., (2009) call for greater attention to the role of values and emotions in environmental learning. These emotive, engaged processes have the potential to stimulate empathy, and catalyze critical engagement into transformative action for sustainability (Heras et al., 2016). Examples of embodied futures practices include experiential futures and gaming tools, as a way for people to cognitively and physically embrace the futures they envision (See Candy and Dunagan, 2017; Candy, 2018).

Such an embodied approach can provide reflective tools for stakeholders and scientists to contemplate together the "what if" (Preiser et al., 2017) and collaborate around how to organize and coordinate action for more just and sustainable futures. The shifting expectations of scientific bodies like the IPCC towards future-making and not just forecasting, imbues such organizations with political power and a responsibility to facilitate discussions about alternative socio-technical and political pathways (Beck and Mahony, 2017). This extends to a need for incorporating more diverse disciplines and knowledge systems in these important intergovernmental processes- something that IPBES has attempted- but where there are still clear gaps (Vadrot et al., 2018).

1.2. Enhancing the role of imagination in scenario processes

In light of these critiques, scientists, practitioners and policy-makers need new ways to engage with such complex global challenges through more participatory and imaginative processes. This reveals the need for epistemological pluralism and transdisciplinary approaches and methods that include a variety of societal groups and non-scientific "experts" – including marginal voices- in the knowledge co-

generation process (Haider et al., 2017; Jahn, Bergmann, and Keil 2012; Miller et al., 2008; Raymond et al., 2010). In contrast to modelling for the purpose of prediction, participatory modelling and scenario processes seek to contribute to co-learning (See Díaz et al., 2013; Evelyn et al., 2010). This means that stakeholders involved in participatory scenario processes bring their interpretations and constructs of reality, experiences and tacit knowledge, which are influenced by many factors (e.g. beliefs, expectations and biases), together with researchers, who can then integrate this information into co-designed models.

In such co-learning processes different knowledges and "understandings take the form of diverse narratives or storylines about a given problem" (Leach, Scoones, and Stirling 2010, p. 4) and can lead to a richer imagining of likely and (un)desirable futures (Tengö et al., 2017). Additionally, participatory scenario development can lead to a social learning outcome. In fact, the appreciation of multiple perspectives helps in understanding multiple facets of an issue, learning together and from one another, enhancing relationships, and thus opening new collaborations and possibilities for future collective action (Johnson et al., 2012).

However, we argue that using participatory methods to co-develop new scenarios, while valuable, is not in and of itself sufficient for building or enhancing systems thinking and social learning towards supporting transformative pathways for more just and sustainable futures. Methodologies that can trigger, involve and elicit more imaginative processes have an additional and often overlooked transformational capacity. Imagination encompasses both cognitive and emotional processes operating at both individual and collective levels (Jensen, 2014; Milkoreit, 2016). Imagination enables people to go beyond their actual experience. In other words, fostering imagination and engaging emotions in participatory and other creative processes helps people to make meaning of the experience itself, which has the potential to create motivation for change.

We argue that more novel ways of co-developing scenarios are required to explore sustainability, equitable development and wellbeing as emergent properties of processes of dialogue and negotiation about what kind of world we want to live in (See Ziervogel et al., 2017). These approaches necessitate the capacity to imagine emergent webs of interconnected ecological, cultural, technological and political factors that combine to create complex challenges for society and the environment. Using imaginative methods and tools for futures thinking (e.g. performance, drawing, storytelling, etc.), facilitates the engagement of the body, and allows for feeling complexity beyond simply understanding it cognitively. This can co-create embodied knowledge by acting out and reflecting upon the uncertainty and surprises of the future, thus provoking critical thoughts and strengthening relational values that may support participants' responses. As suggested by Schultz and Lundholm (2010), such an imaginative approach may be a key element in advancing sustainability learning processes that are expected to transform values and mental models towards more desirable, just and sustainable futures.

Additionally, inventing non-probabilistic futures, outside the constraints of seeking what is likely or desirable, opens up the boundaries of our imagination where the goal is to reduce the fear, disappointment and confusion that novelty can bring (Miller 2013). When people are unable or unwilling to incorporate novelty into the way they think about the future, or to find a place for the emergence of the rich potential of the unknowable, then the lived experience of change becomes disorienting, promoting defensive and nostalgic reactions (Beck, 1992). There is a need to take advantage of the otherwise invisible novelties around us, “overcoming the danger of *poverty of the imagination*, a risk flagged by Karl Popper in the mid-20th century [... and this] could help stave off the appeal of totalitarian methods and colonial approaches that promise to deliver a specific future” (Miller 2013, p. 108).

Accordingly, given the number of initiatives attempting to engage in scenario-based assessments in the pursuit of sustainable and equitable development,¹ further deliberation and exploration of alternative imaginative approaches should be encouraged. In this paper we draw on insights from four exemplars to describe how more imaginative scenario methods can be used to expand futures thinking about sustainability. We propose that developing more imaginative processes, such as in these cases, could be particularly useful in expanding the relevance of scenario assessments by inter-governmental organizations like IPBES whose work lies at the core of the sustainability discourse. We argue that by including more imagination-oriented methods to address the scenario gaps that have been identified in these processes, they are more likely to be able to contribute to the broader goal of sustainability transformations.

1.3. Scenario development in the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES²) is an intergovernmental body that assesses the state of biodiversity and of the ecosystem services that biodiversity provides

to society in response to requests from decision makers. IPBES operates under the joint auspices of four United Nations entities: UNEP, UNESCO, FAO and UNDP,³ and the platform is administered by UNEP through a secretariat in Bonn. Currently, around a thousand international scientists contribute to the work of IPBES on a voluntary basis and are nominated by their government or a relevant organization. Peer review forms a key component of the work of IPBES to ensure that a range of views is reflected in its work, and that the work is completed to the highest scientific standards. The activities of IPBES are structured around a conceptual framework (See **Figure 1**) and include a global assessment along with four regional assessments as well as methodological and thematic assessments. Scenarios and modelling approaches are relevant to most of the activities within IPBES assessments. However, there has been an expressed need to take a novel approach to scenarios in current and future IPBES activities (Kok et al., 2016; Rosa et al., 2017).

The IPBES process and associated assessments need to provide an evidence-base for informing decision-making processes that operate across scales, e.g. jurisdictions (municipal to national), spatial scales (local to global) and temporal scales (short to long term), in order to inform the design of policies and practices that will maintain biodiversity and ecosystem services in support of current and future human wellbeing (Díaz et al., 2015). Thus, a key challenge is to co-design multi-scale future scenarios through participatory and other processes that include more nuanced, creative and context relevant narratives that still align with global-scale policy processes such as the Sustainable Development Goals (SDGs), the Convention on Biological Diversity's Aichi targets and goals associated with the ongoing climate negotiations through the UN Framework Convention on Climate Change (UNFCCC). Kok et al., (2016) suggest three options for the future use of scenarios in the IPBES process:

- 1) IPBES uses the most recent set of global scenarios for climate research and extends them for biodiversity and ecosystem services;

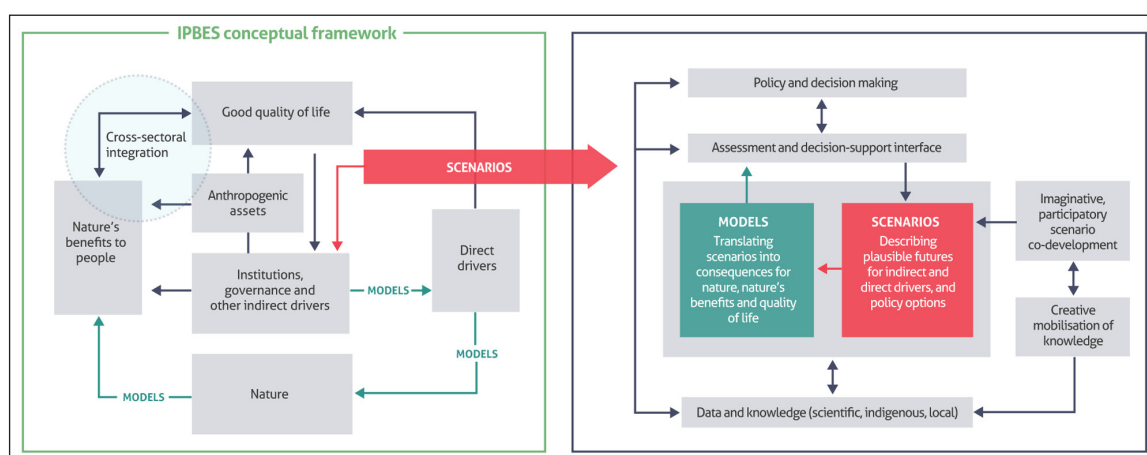


Figure 1: IPBES conceptual framework. An overview of how scenarios are included in the conceptual framework of IPBES and how scenarios and models contribute to policy and decision-making through assessments, formal decision-support tools and informal processes. The grey boxes on the right show where imagination can contribute to the development of new scenarios (adapted from IPBES 2016). DOI: <https://doi.org/10.1525/elementa.374.f1>

- 2) IPBES develops new global scenarios and/or,
- 3) IPBES develops bottom-up, diverse, multi-scale scenarios within a consistent global scenario context.

Similarly, Rosa et al., (2017) suggest two steps: extending global scenarios developed by the climate modelling community, by carrying out a detailed analysis of impacts on biodiversity and ecosystem services; and, an ambitious effort to create a novel set of multi-scale scenarios of 'nature futures' that take into account human development and nature stewardship goals. The last suggestion of both Kok et al., (2016) and Rosa et al., (2017) require in-depth participatory processes that need to be policy-relevant, context appropriate, and legitimately co-developed through processes that mobilise diverse knowledge and value systems (See Cash et al., 2003; Clark et al., 2016; Kok et al., 2016).

Building on these proposals and with reference to the literature, we identify 6 key characteristics that IPBES scenario processes need in order to be more relevant. They need to:

- a. be appropriate for diverse local contexts whilst being applicable across different regions,
- b. include diverse knowledge and value systems,
- c. Promote legitimate stakeholder engagement that recognizes power asymmetries,
- d. be able to grapple with uncertainty and the 'unknowable future',
- e. involve individual and collective thinking about and acting for sustainability and
- f. be directly relevant to policy making.

We argue that explicitly drawing on methodologies that capture the imagination in addressing these gaps will also allow for more transformative outcomes as people can be confronted by radical alternatives; the foundation of successful social movements according to Klein (2014 in Bendor 2018, p.g 134). There is currently a wave of new creative and imaginative foresight techniques in development across diverse disciplines that can help address some of the above criteria (Raven and Elahi, 2015; Miles et al., 2016; Palazzo et al., 2017; Vervoort and Mangnus, 2018; Vervoort, 2018). Such techniques have already started to be applied in the field of climate change, for example in work referencing post-carbon futures and how to stay below 1.5 degrees of warming (Beck and Mahony, 2017; Nikoleris et al., 2017; Hajer and Pelzer, 2018; Vervoort and Gupta, 2018; Hajer and Versteeg, 2018). To date, there is comparatively little creative scenario development or futures thinking in the broader area of social-ecological systems or biodiversity conservation (Oteros-Rozas et al., 2015).

As yet, these new methods have not permeated into the still very conventional space of environmental assessments. This is perhaps not at all surprising given the inherently political and highly cautious nature of the multilateral institutions responsible for undertaking environmental assessments where the introduction of 'creativity and imagination' can be seen as politically fraught and potentially damaging to the legitimacy of the organization that has to balance political demands in order to continue its

work (For an overview see Keohane, 1988; Oates, 2017). Obermeister (2017) reflects on an even deeper problem in highlighting the epistemological incompatibility and fundamental challenge of incorporating diverse alternative knowledge systems into environmental assessment processes. Something that they are not designed to do and that has been a historic problem. However, scenarios offer up a well-established, existing format through which the imagination can be more clearly enrolled in such science-policy interfaces. As a strategy for communicating possible sustainability pathways, being able to offer up alternative futures that contest existing imaginaries (e.g. of ongoing ecological crisis) is a critically empowering aspect of future-making techniques that employ the imagination (Bendor, 2018).

We therefore argue that to meet the above criteria, more imaginative scenario processes need to be nested within the overarching IPBES process (see **Figure 1**), especially if the biodiversity and ecosystem services sector is to stay up to date with the cutting edge of futures work for sustainability. In response to the dual challenge of a crisis of imagination raised by Bendor (2018) and the need for acknowledging diverse knowledge systems raised by Obermeister (2017), we propose that the incorporation of the practice of imagination within the scenario processes of international environmental assessments (that aim to incorporate diverse voices and knowledge systems) may in itself help to break down the barriers of epistemological incompatibility. In the following section, we describe the contribution of art-based research methods for fostering imagination for transformation and then go on to outline four different, but complementary, approaches that have been used to create more imaginative visions of the future. We conclude with suggestions as to how these different approaches can be incorporated into the IPBES process to generate more vibrant scenarios that move towards meeting the above criteria.

2. Fostering imagination and transformation through arts-based research techniques

By incorporating the processes, forms and approaches of artistic practices into science-policy processes (Sinner et al., 2006), arts-based research attempts to redefine and extend beyond the constraints of interdisciplinary research that exist due to the abovementioned 'imagination gap' when addressing complex social-ecological challenges (Milkoreit 2016). In the context of scenarios for environmental assessment processes like IPBES that rely on existing published research for their reports, we posit that drawing on arts-based approaches for exploring visions of the future may stimulate stakeholders' imaginative inquiry about possible futures and how they may be translated into more innovative and concerted lines of actions. This would require science-policy processes to broaden their methodology and address disciplinary and epistemic biases when conducting assessments and selecting experts (Vadrot et al., 2016; Vadrot et al., 2018), which is an issue that the IPBES Values assessment⁴ which commenced in November 2018 is attempting to address.

Eisner (2008) identifies different genres and forms of arts-based research, including literary forms (e.g., creative non-fiction or storytelling), interpretative biography,

performances (e.g., applied theatre, dance and movement or performative inquiry), visual arts (e.g., painting, photography and social sculpture) and new media (e.g., video, podcasts, and radio). For the purposes of this paper we have considered four scenario case studies that make use of all these forms of arts-based research practices, except for interpretative biography because as far as the authors are aware, it has not been applied to scenario generation processes thus far.

2.1. Literary forms: narratives and storytelling

A variety of literary forms, such as narratives and science fiction storytelling are increasingly being recognized as important methods through which to capture the imagination in thinking about sustainable futures (Milkoreit 2016). For example, the renowned academic journal, *Nature*, has already legitimised the incorporation of imagination and storytelling for thinking about possible nature futures in their two anthologies on 'Nature Futures' where some of the most famous science-fiction authors were asked to write short stories imagining what the future could look like (Sullivan and Gee, 2014; Gee and Sullivan, 2018). The 'Futures' section is now an established feature in *Nature*. Massachusetts Institute of Technology (MIT) has taken a similar approach through the publication of its 'Twelve Tomorrows: Stories of the Near Future' anthology series in the MIT technology review (MIT, 2014). Climate fiction, known colloquially as 'cli-fi' has similarly been used to capture the world's imagination on the need to respond to climate change (see Milkoreit, Martinez, and Eschrich 2016).

Storytelling techniques are also able to engage with diversity, leveling playing fields and surfacing power dynamics, as encapsulated in this quote by Ben Okri (2015, p. 23) "*We speak of life in society and in communities, we speak of politics and government, but there is finally only one life – stories are holistic because they address all aspects of this one life... storytellers, reclaim your power to shape the future through stories.*" Highlighting the increasing resonance of these approaches, in 2017, the X-prize foundation⁵ announced the creation of the 'Science Fiction Advisory Council' which brings together 64 of the world's leading sci-fi authors and filmmakers to imagine positive futures for humanity on a rapidly changing planet as well as focusing on the gap between the present and the future (Bankston, 2017). Finally, the lead editorial in *Nature* in March of 2018 was about using science fiction storytelling to tell diverse tales of the future and featured one of the scenario case studies highlighted in this article (Nature, 2018).

2.2. Performances: applied theatre

Theatre has been historically used to represent the world as we understand it and deal with the struggles in human lives and the unease of the unknown. However, in the words of the father of the *Theatre of the Oppressed*, Augusto Boal, theatre "can and also should be a means of transforming society. Theatre can help us build our future, rather than just waiting for it" (Boal 2002, p. 24). Several initiatives have shown the potential of theatre to strengthen our imagination in order to create novel solu-

tions for complex social-ecological problems (See Guhrs, Rihoy, and Guhrs 2006; Pratt and Johnston 2007; Heras, Tábara, and Meza 2016). But to imagine novel futures, we need to learn and practice (Milkoreit 2016). Applied theatre techniques, as well as dance and other techniques involving corporal movement, provide the perfect means for embodying learning. The process of imagination is encouraged by the creation and/or performance of a play, and both audiences and actors are challenged to imagine and embody the situation under analysis, "organically link[ing] and integrat[ing] analytical intelligence, emotional intelligence and the intelligence of the body" (Heras and Tábara 2014, p. 381). Then, by trying to experience it in first person, they are able to act-out radically different solutions. Applied theatre can provide participants with meaningful contexts to explore intricate concepts, e.g., illustrating the interdependence of the social and ecological domains (McNaughton, 2014). It allows the practice of a variety of skills (e.g., imagination and empathy through role playing), and is a powerful tool to enable the dialogue between powerful and marginalised groups, and can be used to explore solutions to conflicts between those who hold opposing perspectives (Guhrs et al., 2006).

2.3. Visual arts and new media

Visual arts and new media are useful tools when exploring unknown futures and they frequently appear integrated in other types of art-based research. For example, the physical theatre performance *The Bond You Hold*⁶ created under the project IMPRESSIONS⁷ has a strong dance, music and video component. Set in a world beyond 2°C warming, it represents the complex and dynamic relation between humans and climate. Another new media form which offers potential for kindling the imagination is the rise of the podcast. One example is *Flash Forward*⁸ which every week takes a particular scientific 'what if' scenario, presents a short radio play or excerpt of that speculative future and then discusses it with scientists and others. Finally, the paper by Galafassi et al., (2018) 'Arts in a warming world' presents a large number of initiatives that use diverse visual arts and new media forms to explore, express and engage with the science of climate change.

3. Imaginative futures: art-based research case studies in participatory scenario approaches

In order to explore the role that imagination can play in scenario processes, we draw on four creative processes in which each of the authors has been involved and that

- a) represent a variety of art-based research techniques according to the Eisner (2008) classification;
- b) incorporate or have the potential to incorporate participatory methods;
- c) have been implemented to explore future scenarios focused on sustainable transformations through transdisciplinary dialogues between artists, scientists and stakeholders (e.g. decision makers, civil society and practitioners); and
- d) have some data available for a comparative analysis of their main outputs and limitations

e) explicitly reference techniques for involving the imagination and in fostering alternative collective imaginaries (See Bendor 2018).

The four creative processes are:

1. The Seeds of Good Anthropocenes⁹ project aims to counter existing dominant dystopian visions of the Anthropocene by using a novel participatory scenario generation method that starts with existing ‘seeds’ of positive actions taking place in the world right now that if grown and combined, could lead to a more desirable future.
2. The Museums of the Future Now¹⁰ project is an evolving series of speculative artworks and workshops designed to engage people in an exploration of the environmental, social and economic factors that are combined to create the complex challenges that we face as a society.
3. The AKWA¹¹ project is a play set in Spain in 2026, ten years after the last drop of water has come out of the tap, that explores how a community might experience life and remember (or not) a world in which water was freely available and publicly owned.
4. The Radical Ocean Futures¹² project consists of four short scientifically grounded science fiction narratives of potential ocean futures that are each supported by both a visual and a musical interpretation to stimulate the imagination through multiple entry points.

Table S1 describes each of the four case studies, outlines the processes they followed, and the details and outcomes of the projects as well as their limitations. We make use of data collected for these projects that has been published elsewhere (See **Table 1**).
Drawing on these four cases, we provide some insights into processes for envisioning imaginative futures and present options for shifting away from business-as-usual

approaches in how scenarios are constructed and adopted in the areas of biodiversity and ecosystem services. We explore the utility of specific features of these processes for their relevance in meeting IPBES scenario needs (adaptability across diverse contexts, inclusion of diverse knowledge and value systems, legitimacy of stakeholder engagement focusing on sensitivity to power asymmetries, an ability to deal with uncertainty and the ‘unknowable future,’ individual and collective thinking and relevance for policy-making) and conclude by drawing out lessons from these processes to inform more relevant scenario co-development and assessments for IPBES.

3.1. Complementarities across the cases

We compared each of the four arts-based cases using the six criteria outlined above as an analytical framework (**Table 2**). Each of the four cases illustrate how process that draw specifically on the imagination can be harnessed in different ways to meet the needs of the IPBES scenario process.

a. Adaptability across diverse contexts

The literature increasingly points to the need for the outcomes of scenario processes to be contextualized and to avoid being overly generic and thus of limited usefulness across a diversity of contexts, for example in terms of cultural distinctiveness, socioeconomic factors, and ecosystem dynamics (Bennett et al., 2016; Kok et al., 2016; Obermeister, 2018). We argue that it is important that scenario methods and tools are able to account for local differences (social, cultural, biophysical), but also be applicable for synthesis across a wide range of scales.
With the exception of the Radical Ocean Futures project, the processes presented in the cases took place in specific locations, often with a local focus, and the methodologies employed were adapted to be appropriate for the context in which they took place or were able to reflect this specific location. In the case of the Seeds workshops,

Table 1: Different types of art-based research that is grounded in stimulating individual and collective imaginations and how they are represented in our case studies. DOI: <https://doi.org/10.1525/elementa.374.t1>

Case studies	Type of art-based research that engage the imagination			Data collection and reference
	Literary forms	Performances	Visual arts and New MediaNew media	
The Seeds of Good Anthropocenes:	Story telling	Dance, role-playing	Graphic artists, Video reflections, Whiteboard video	Notes from participant observation, semi-structured interviews; Reference: Pereira et al., 2018
Museums of the Future Now	Story-telling Creative non-fiction		Creation by artists of an inspiring museum and objects	Notes from participant observation; evaluation on-line interview; Reference: Heras et al. in prep.
AKWA		Applied theatre, dance, movement	Video, music	Notes from participant observation; Reference: Jiménez-Aceituno et al., 2015
Radical Ocean Futures	Science fiction prototyping narratives		Digital Concept Art, Music, podcast episode, annotated web stories (ocean futures presented as blog entries).	Reference: Merrie et al., 2017

Table 2: Relevance of different case study approaches to key IPBES scenario needs. DOI: <https://doi.org/10.1525/elementa.374.t2>

Cases	IPBES Scenario needs					
	Adaptability across diverse contexts	Inclusion of diverse knowledge and value systems	Legitimacy of stakeholder engagement and power asymmetries	Ability to deal with uncertainty	Individual and collective thinking	Relevance for Policy-making
The Seeds of Good Anthropocenes ("Seeds")	Yes	Yes	No	Yes	No	No
Museums of the Future Now ("Museums")	Yes	Yes	Potentially	Yes	Yes	No
AKWA	Yes	Yes	Potentially	Yes	Yes	No
Radical Ocean Futures	No	Potentially	No	Yes	Yes	Yes

they were able to draw on local languages and meanings to supplement some of the meaning in the scenarios. For example, one of them was entitled *Demos42 Ubuntu*, which refers to the spirit of 'Ubuntu' regarding the interdependence of humanity. Social theatre initiatives have also shown a great versatility to adapt to specific contexts. The performance of AKWA was developed in multiple locations with a variety of audiences, generating different strategies for adaptation, such as, the evolution of the topic from water privatization to fracking aimed to specifically link with relevant current social-ecological concerns (Jiménez-Aceituno et al., 2015).

In the case of Museums, the location is defined by the initial information given to the participants to create the narrative. Thus, the narrative is appropriate and able to be context specific, as this diversity and specificity is reflected in the details of the differing trajectories. For instance, talking on food for the future, agri-food systems are analyzed differently when rural versus urban worlds are explored, and specifically the project looks at different regional implementation of strategies. By contrast, the case of Radical Ocean Futures did not explicitly take place in a given location. However, the narratives had vivid illustrations of the regional and the local. For example, in the science-based, but fictional 'Rising Tide' narrative scenario, a diverse group of nations (all bordering the 'coral triangle' of the Pacific Ocean) confederate to form the 'Oceania Confederation' and build a resurgent civilization under the oceans as they face and overcome the challenge of radical sea level rise. It is important to note however that this collaboration was invoked in the narrative drawing on the scientific foundation, but the actual scenario building process was not in itself participatory.¹³

It is important to recognize that not all methods of engagement are equally appropriate in all contexts and that this needs to be adjusted depending on the local context. This is important when thinking about cultural norms and acceptable social behaviours, which vary greatly depending on the stakeholder composition and could dampen stakeholder engagement with issues. Here,

activities involving role playing could assist with giving a voice to more marginal actors (D'Aquino et al., 2003; Pahl-Wostl and Hare, 2004). Unfortunately, the ability to scale from local or regional initiatives to more globally appropriate findings is still lacking and further work needs to be done on how to bridge these innovative, engaged processes at a broader level. While context appropriateness can assist with the legitimacy of processes, scale mismatches may occur in terms of policy relevance. However, most development activities are implemented at a local level, and while negotiations might happen at higher governance scales, understanding the local context can assist with envisioning and implementing more locally relevant futures and interventions (Chapin et al., 2010).

b. Including diverse knowledge and value systems

Here, we refer to epistemological inclusiveness as an important component of arts-based research and participatory methods, emphasizing the need to transcend the limited boundaries that sometimes constrain science in futures thinking (Scheffer et al., 2015; Vervoort et al., 2015; Galafassi et al., 2018). It also includes rethinking the assumptions and worldviews that guide the construction of knowledge and create new spaces that give voice to diverse participants to raise issues of their concerns and facilitate critical dialogues among them (Tengö et al., 2017).

Each of the cases offers innovative methodologies for co-creating knowledge with scientists and incorporating multiple value systems that differ among participants who have a variety of backgrounds. This is especially interesting in the Museums case, which co-opts the institutional authority embodied by a museum, but in a playful way that encourages curiosity and participation. It gives participants (Museum visitors) permission to tell each other stories about their issues, concerns and aspirations for the future through a fun activity. These stories not only tell us something about how we imagine the future, but also something about different desires, anxieties, dreams and values which drive actions in the present. AKWA, for

its part, was a performance created under the principle of “embracing [all kind of] ideas, challenges and problems to work through [which] allows to untangle notions that might seem immovable” (Jiménez-Aceituno et al., 2015, p. 284). Thus, the methodology adopted by the creators (i.e., the artistic collective CACTUS) required changing perspectives many times, to be able to include the diversity of understandings, feelings and emotions held by the different members of the group. Furthermore, sharing the leadership, by working with a role-changing dynamic that avoids having a fixed group leader, was another of the strategies conducted by CACTUS to foster co-learning and include diversity. As a result, AKWA introduces a variety of characters that present many perspectives around the water conflict. Likewise, the final interaction of the audiences with the actors to discuss the different perspectives of these characters allows participant to express their own concerns, ideas and values regarding the water conflict and testing different emerging proposals for action, their relevance, acceptance and desirability (see Table S1).

In the case of the Seeds project, whilst there was a limited group of people in the room, care was taken to ensure that a cross-section of backgrounds, races, ages and experiences were in each of the groups (See Pereira et al., 2018). Furthermore, the use of stories as a way of articulating the visions of the groups enabled everyone to engage on the same level – as storytellers – without the need to reference specific expertise that would have brought power dynamics into focus and risk derailing the process. Although the Radical Ocean Futures case did not explicitly draw on diverse knowledges to construct the narratives, its artistic base enables those engaging with the images, who may be initially be interested on an aesthetic basis or through knowledge of the artist’s work, to begin to ask questions of the science and policy of the future oceans. The images, the narratives and the music worked separately and together as effective boundary objects to engage those interacting with the project as a visual exhibition and raise their own questions regarding the future oceans from their own unique perspectives.

c. Legitimate stakeholder engagement that is sensitive to power asymmetries

Involving a wide and diverse range of stakeholders may ensure a diverse pool of ideas, however, legitimacy refers to more than the diversity of those that are included. Legitimacy is related to how stakeholders might perceive their divergent values and beliefs have been respected and acknowledged in the process (Clark et al., 2016).

Using imaginative processes such as performance and creative fictional narratives, bringing together a diversity of stakeholders in new settings and refining, adapting and adopting inspiring role-playing tools can enable a better understanding of power dynamics and what legitimacy might mean in different socio-political contexts (Chaudhury et al., 2013; Hajer and Pelzer, 2018). In both cases of the Seeds and the AKWA projects, the performances work on the direct reproduction of existing and situational power relations and the particular understanding of how the future may be conceived depends on the enactment of those relations. Moreover, by triggering or

facilitating an emotive and immersive response through activities like role-playing or engagement with an object, the Museums project can remove some of the inherent power asymmetries when people are speaking from specific invented societal roles and power dynamics can be navigated and political roles put into new perspectives, sometimes with surprising outcomes (See Heras and Tábara, 2014; Brown et al., 2017).

A more inclusive approach that considers how different social categories intersect in relation to power asymmetries (e.g. class, gender, ethnicity etc) also provides pointers for researchers and practitioners to reflect on their own assumptions and ask questions that can surface how problems are experienced, identified and rationalized within specific contexts (Hankivsky, 2014). Of the four cases, two were more curated with participants being purposively selected to bring in a diversity of values and knowledges (e.g. Seeds; Radical Oceans), and two relied on engaging spectators who arrived at the scene (Museums, AKWA). How knowledge is mobilized, translated, negotiated, synthesised and applied (Tengö et al., 2017) depends on the methodologies and facilitation of the process. New roles of researchers are acknowledged in process-oriented approaches to sustainability science (Lang et al., 2012; Wiek et al., 2012). Here, having reflexive skills and competences of researchers as facilitators who can respond to the dynamics in the research setting, e.g., power asymmetries or dominant voices, is critically important (Kunseler et al., 2015). For Radical Ocean Futures, the method of creating science fiction prototypes was in itself an experiment for applying this method to transformative sustainability scenarios. Through the application of science fiction prototyping alongside complementary scenario methodologies, the process facilitated legitimacy by being sensitive to and highlighting power asymmetries in the prototype construction process (Merrie et al., 2018).

d. Ability to deal with uncertainty and the ‘unknowable future’

Equally important is the ability of creative scenario processes to capture dynamics of complex systems and to be able to incorporate irreducible uncertainty and the unknowable character of the future (Poli, 2010; Miller et al., 2013). The four cases present four different approaches towards fostering imagination for dealing with uncertainty when envisioning the future. Futures literacy, that is, the capability of offering insights on how to approach unforeseeable challenges by using the future to innovate in the present, is a fundamental underpinning of the processes undertaken in the Seeds project. The Seeds method was specifically facilitated to enable participants to engage creatively with the far future by extrapolating from potentially positive things that are happening now, but that are still marginal, for example a social movement like Slow Food or a technology like blockchain (Pereira et al., 2018). Furthermore, the participation of both scientist/practitioners and artists throughout the process ensured that imagination was intrinsically woven into the scenario building process.

For Radical Ocean Futures, the origin of the project helps explain how it accounts for uncertainty and how this differs from the way that uncertainty is considered and

indeed reduced in classic quantitative and analytical scientific scenario processes. The lead author of *Radical Ocean Futures* (Merrie, 2017) was part of an interdisciplinary research project that brought together scientists from all over the world to “predict the future ocean”. Participating in that project led the author to ask some questions that fell into the abyss between what can confidently be said with the best marine science (what we can “predict”) – and what imaginative, but entirely speculative thinking about oceans detached from the science would look like. Where was the bridge between known and unknown, and how could what was known be connected to what it meant for humanity and other species? Science-fiction prototyping was applied as a way to bridge that gap and think about the possible futures of fisheries and the oceans and to directly confront true uncertainty by incorporating fast change, slow change, cascading effects, radical uncertainty, and surprise into the narrative scenarios. The project faces and deals with uncertainty through bridging the gap between the known and predictable to the unknown and unpredictable, or the unlikely but possible.

e. Involve individual and collective thinking about actions for sustainability

In order to move towards more sustainable and just futures and for institutions like IPBES to be able to craft more inclusive scenarios for sustainable futures, it is necessary to consider how to incorporate thinking about actions for sustainability at both the individual and collective level (McGrath, 2002; Floyd, 2012; Boyd et al., 2015; Sitas and Pieterse, 2017).

Individual cognitive-emotional processes are mainly involved through the experience of hearing, touching, smelling the stories of the future that people imagine through these approaches. Additionally, long-term future thinking applied to sustainability in complex systems requires a systemic imagination that is able to capture a broad range of phenomena in the social and natural dimensions, their dynamics and multiple feedbacks. The ability “to create sets of mental representations of what is not yet present” and “rely on memories of the past when trying to anticipate future” (Milkoreit 2017, pg 5) is highly potentiated by the visual and the performative arts. In this sense, embodying experiences of future, as in the case of AKWA, means provoking thoughts on complex concepts through feeling and sensing them (i.e. experiential learning). As suggested by Boal (2009) for the Theatre of the Oppressed, by Nicholson (2005) for Applied Drama and by Heras and Tàbara (2014, 2016) for participatory theatre, sharing experiences that resound in the body and in emotions become crucial in increasing sense-making and engaging self-awareness and responsibility on actions that may have repercussion for the future.

In the *Radical Ocean Futures* and the Museum project, the science fiction writing and the creative storytelling around concrete objects that allowed people to express their different meanings and cognitive imaginary, to engage with their emotions and beliefs, and at the same time to bring participants in an immersive experience of future possibilities. The Museums methodology used narratives, helped by artistic objects as a source of creative

inspiration, to describe envisioned futures. Social theatre experiences for envisioning the future, like AKWA, move back and forth from the physical body to the cognitive and the emotional. Through this iterative process, each body movement becomes a thought and each thought is expressed with the body. As a result, the whole body is thinking – and creating- and not just the brain, but also the emotions and knowledge are revealed and mobilized physically (Boal, 2002).

Indeed, imagination is a social process, because it's shaped by communication among people in a specific environmental and social context, and because it potentially reinforces new social interactions. For instance, the ephemeral universe of interactions created by applied theatre, dance or collective writing and storytelling may foster relational learning, sharing others' perspectives and displaying collective cognition processes (Milkoreit and Mock, 2014; Hajer and Pelzer, 2018). Thus, such artistic laboratories may turn into spaces for shared creation and expression of direct democracy that allow collaboratively engaging participants to be active agents of their own futures (Sharp et al., 2005; Clements, 2008; Sholette, 2011; Sitas, 2017; Sitas and Pieterse, 2017). Extending these methods to be democratically participatory could enable a shift from individual transformations to transformative change at the collective or societal level (McGrath, 2002).

f. Direct relevance to policy-making

The arts-based processes compared in this paper did not demonstrate a direct link to a specific policy-making context; the one limited exception is that the *Radical Ocean Futures* project was on display at the entrance to the United Nations during the first ever General Assembly on the oceans in New York in September 2017. This is an important consideration for future scenario processes whereby the processes need to include decision-makers in the imaginative practices from the outset, in addition to identifying policy opportunity contexts for implementation (Reyers et al., 2015; Rosa et al., 2017). Gaming as a method for enacting embodied futures offers some of the best examples of how creative methods that capture the imagination can be used to engage directly with stakeholders in political contexts (See Candy, (2018) discussing the example of *The Thing from the Future* game and Vervoort, (2018) for a broad overview). Most of the current intergovernmental policy processes e.g. SDGs, Aichi targets and regional initiatives like the African Union's Agenda 2063 include strong aspirations for a more equitable and just future, which align with the desires and hopes of most people. Accordingly, while policy processes might seem like more linear processes with goals, targets and associated quantifiable indicators, we argue that the mobilization, implementation and co-development of innovative solutions to achieve goals of such intergovernmental policy processes, require novelty, creativity and a re-imagination of what sustainable futures might look like in a rapidly changing world.

In light of this, authors of the *Global Environmental Outlook (GEO 6)* process of the United Nations Environment Program recently decided to use an adapted Seeds approach for engaging more directly with diverse

stakeholders during the development of a more innovative outlooks section. Workshop outputs from meetings held in Bangkok, Nansha, Nairobi and Singapore explain the process that was followed and concluded that it was important to explore these more participatory and creative processes to enrich traditional modelling methods in thinking about environmental futures and, synthesising information in different ways (UNEP, 2017a; UNEP, 2017b; UNEP, 2017c; UNEP, 2018). The added benefit of this process is the capability to incorporate specific policy relevant pathways into the information in the outlooks section (Pereira et al., 2019). By directly engaging with UN Environment stakeholders in different global regions, it is possible more explicitly to relate these creative processes to policy and broader decision-making processes. A similar process has also been started within the IPBES expert group on Scenarios and Modelling where an approach adapted from the Seeds visioning workshop was used in a global participatory process for envisioning positive futures for nature (Lundquist et al., 2017).

There are barriers to having participatory policy engagement processes at regional and global levels. Two obvious barriers are resource constraints, such as time and money (See Sitas et al., 2014). Key decision-makers are often too time-constrained to be able to engage in immersive participatory processes and can often only be convinced to take part once the value of the approach has been clearly demonstrated. It becomes a chicken and egg situation because the involvement of the ultimate users from the beginning is important in order to ensure that something useful is produced, but these are the very individuals who are too time constrained to take part in processes of co-production. Participatory processes, especially at regional or higher levels can also be extremely expensive as the experiential nature of creative processes requires peoples to meet in person, usually for more than a day and this can have significant budgetary implications. In addition, much of policy development and engagement is conducted under fairly rigid constraints and a set of bureaucratic norms that determine conduct and process and help to set expectations. Introducing an imaginative, participatory process into policy development could be perceived as being highly risky and no particular individual policymaker or institution would be willing to risk reputational damage or creating new accountabilities that they could not support.

Despite these constraints, creating instances for 'intelligent' policy making built on policy learning rather than on the generation of 'evidence' is of growing relevance (Sanderson, 2009), especially if the aim is to generate policy that is resilient over the long term (Nair and Howlett, 2016). There is thus a shift towards recognizing the need and investing resources into participatory processes that could generate beneficial outcomes for policy and other decision-makers.

4. Including imagination in Intergovernmental Scientific Scenario Processes

"Arts and sciences may seem opposite poles at first sight. Arts speak to the heart, sciences to the ratio. Yet there are important similarities too. Both are

looking for the essence of things and both need creativity and perseverance" (Scheffer, Baas, and Bjordam 2017, p. 1)

The idea behind these four cases is not to offer a silver bullet solution to improve the IPBES scenarios – and indeed each of the methods have limitations, as described in Table S1- but to present some tools that together may serve as a good point to start reformulating methodological approaches towards incorporating more creative and imaginative processes in biodiversity conservation and ecosystem services research. A prior review of 23 participatory scenario planning experiences (Oteros-Rozas et al., 2015) recognized the valuable role of the arts in communicating results from the envisioning exercises; however, it also recognized the need to further explore their role as an integral part of the process.

This paper explores potential benefits of imagination-oriented arts-based scenario processes, which has resulted in four tenets. Imaginative processes can 1) foster the translation and understanding of complexity and increasing awareness of systemic interactions and uncertainty; 2) promote the integration of emotions, feelings and rational and irrational judgments to better understand complex sustainability challenges and co-create novel solutions; 3) mobilize and weave different kinds of knowledge and perspectives into a collective dialogue for a more sustainable world that can foster commitment to action.

Firstly, the four cases outlined in this paper put the imaginative process front and centre and moved beyond a routine participatory process to instill in actors a capacity to deal with complex issues and the unknown. Buell (1995) has pointed out that (social) environmental crises; "involve a crisis of imagination, the amelioration of which depends on finding better ways of imaging nature and humanity's relation to it" (Buell 1995, p. 2). Despite the (sometimes) general assumption that imagination is synonymous with the unreal and untrue, a variety of interdisciplinary research (Jensen 2014) has suggested that imagination is "both used to mentally imagine experiences as well as understand perspectives that cannot be experienced directly, [...] mentally present(ing) to ourselves things that are not present" (Dewey 1902 in Jensen 2014, pp. 64 and 127). As a result, imagination emerges as a powerful tool to deal with uncertainty and the unknowable future. However, as it happens with the acquisition of new skills, imagination requires learning and practice. Thus, creativity and the arts allow for and encourage the craft of imagination (Jensen, 2014). There are a variety of artistic genres, methods and games from different approaches to stimulate the imagination. These exercises and games aim to relieve the pressure and do not attempt to force creativity, allowing the participants to trust in letting *something occur*, rather than *making it occur* (Bogart and Landauthe, 2005).

Secondly, the different methodologies of transformative art-based research explored by our cases encompassed with the idea that emotions play a central role in the decisions we make (Jacobson et al., 2007). On the one hand, it is widely recognized that transformative learning requires working with our senses and emotions (see, e.g., (Mezirow, 1997; Sterling,

2010). While some traditional approaches have used a combination of fear and information on trying to influence behavior, they have failed to move or engage with the public. Transformative learning necessitates “connect(ing) with people’s values, emotions and desires, present(ing) positive and realizable visions, and reconcile(ing) people’s existing sphere of concern with their perceived limited sphere of influence through facilitating their ability to engage in change” (Sterling, 2007, p. 74). On the other hand, the different approaches and methods showed by the four cases assume – and reinforce – the fact that thinking, emotions and feelings are strongly interconnected (Boal, 2002), while pulling apart a more traditional worldview built over dualisms – mind/body, masculine/feminine, production/reproduction, reason/emotion, ordinary/extraordinary, knowledge/experience, culture/nature, us/them (Plumwood, 1993). Thus, we argue that processes and spaces that enables participants to engage with emotions, feelings, beliefs, and complexity should be included in deliberative processes for thinking about coupled social-ecological futures.

Third, our findings challenge some recognized limitations of arts-based experiences and their integration in social and political processes. Indeed, the outcomes of our comparison of these four cases can add value to the ongoing IPBES process which necessitates the co-development of new bottom-up scenarios (Rosa et al., 2017). The cases we highlight illustrate options for how scenario development processes can broaden participation and mobilize diverse ways of knowing and learning within sustainability research, practices and politics (Pohl et al., 2010). Drawing on the existing literature (Heras and Tàbara, 2016) and reflections on the four projects, we argue that there is value in fostering more inclusive and creative participatory processes, which acknowledge the importance of understanding multiple value systems, knowledge systems and relationships between diverse actors in order to re-imagine a more inclusive and just future. This enables a move away from the conventional understanding of scenario development towards fostering participants’ awareness about their role in becoming an active part of their own futures and opening communicative processes in lieu of conventional linear thinking and constrained visions of futures. From this a critical research gap emerges to address exactly what kind of long-term value these imaginative processes add and how we can learn from ongoing assessments that are trying to embrace a more artistic and participatory approach (See Galafassi et al., 2018). Specifically, new roles of researchers also emerge, with new competencies built from the reflexivity needed to undertake this co-production process (Heras and Tàbara, 2016; Pereira et al., 2018).

The four cases of imaginative scenario initiatives, while not all directly related to the design of future scenarios about biodiversity, ecosystem services and human wellbeing, present a variety of arts-related innovative methodologies aimed to guide different stakeholders through a transdisciplinary dialogue to envision more transformative futures and the co-construction of suitable solutions for local challenges of global relevance. They present examples

of how more creative and potentially transformative knowledge co-production processes can be facilitated through arts-based research, like storytelling, performances, visual art and new media. The cases also point to what trade-offs or balance might emerge or be needed, e.g., processes embedded within locally legitimate practices, but not applicable to broader regional issues or globally focused scenarios with only tenuous links to local contexts.

Thus, we conclude that the arts and their associated creative methods, present exciting opportunities to explore new ways to envision the future. These more imaginative methods can transcend business-as-usual based approaches that have so far failed to facilitate the transformation needed for a more sustainable and equitable world. As Bendor (2018, pg. 158) notes, “the imagination is a means for breaking the seductive yet nefarious hegemonic view of the given as the only possible reality—to achieve the velocity necessary to escape the gravitational pull of the here and now... Since we must be able to imagine change before we can pursue it, interactive media can support the transformational capacity of the imagination in several ways.” Creative scenario co-development processes that promote and encourage imagination and more empathetic responses should be considered as tools complementary to the suite of methodologies currently used to develop future IPBES scenario for exploring how societies might be organized in the future to build a more sustainable and desirable Anthropocene.

Data Accessibility Statement

The authors have no data accessibility statement to declare.

Notes

¹ Such as the Intergovernmental Panel on Climate Change (IPCC), UN Environment’s Global Environmental Outlook (GEO) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Service (IPBES).

² www.ipbes.net.

³ UNEP- United Nations Environment Program.
UNESCO- United Nations Educational, Scientific and Cultural Organization.

FAO- Food and Agriculture Organization of the United Nations.

UNDP- United Nations Development Program.

⁴ <https://www.ipbes.net/deliverables/3d-values>.

⁵ <https://www.xprize.org/about/scifi>.

⁶ <https://vimeo.com/142046379>.

⁷ www.impressions-project.eu/.

⁸ <https://www.flashforwardpod.com/>.

⁹ <https://goodanthropocenes.net>.

¹⁰ <https://museumsofthefuturenow.wordpress.com/>.

¹¹ <https://teatrocactus.wordpress.com/obras-y-creaciones/akwa/>.

¹² <https://radicaloceanfutures.earth/>.

¹³ For more detail about the Science Fiction Prototyping methodology used in the Radical Ocean Futures Project, please refer to Table S1.

Supplemental file

The supplemental file for this article can be found as follows:

- **Table S1.** Table detailing the four cases of imaginative scenario processes in terms of project descriptions, project process, project outcome(s), and limitations. DOI: <https://doi.org/10.1525/elementa.374.s1>

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Figure design credit: Jerker Lokrantz/Azote.

Competing interests

Laura Pereira, Nadia Sitas and Federica Ravera are all experts nominated to IPBES.

Author contributions

- Substantial contributions to conception and design: All authors
- Acquisition of data: All authors
- Analysis and interpretation of data: All authors
- Drafting the article or revising it critically for important intellectual content: All authors
- Final approval of the version to be published: LP

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